Research Article

Corralling a Chimera: A Critical Review of the Term Social Infrastructure

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A growing body of literature - from disciplines including economics, engineering, finance, public policy, sociology, and urban planning - uses the phrase *social infrastructure*. Despite its increasing popularity, there is little agreement on its definition. Through a review of nearly 130 articles from a variety of platforms, trade publications, peer-reviewed journals and reports across a variety of fields from 1960 until the present, we demonstrate that essentially all references to the term can be categorized into five areas: education, healthcare, housing, transport, and networking spaces. Based on our analysis of the term, the confusion generated by alternative uses, and a recent shift in usage, we encourage scholars to use the definition centered on networking spaces. With this new focal point, we hope to better unify these fields and underscore the degree to which these facilities support critical connection-building processes across societies.

Introduction

Multiple types of infrastructure undergird all societies, providing much-needed capacity for transportation, telecommunication, energy, and water systems, among other fields. Transportation infrastructure, such as highways, bike lanes, bus rapid transit lanes, and other often concrete-based structures, fits comfortably in the category of *gray infrastructure*. Designers call structures that mimic natural environmental features that can absorb carbon dioxide or flooding "*green*" or "*blue*" *infrastructure* (Campbell 2022). Examples of green infrastructure include green roofs, rainwater harvesting systems, and mangrove forests (Aldrich and Page-Tan 2020). Other categories of infrastructure, though, despite broader benefits, elide precise definitions.

Specialists have used the phrase *social infrastructure* since the 1960s when economists and development specialists applied the label to investments intended to change the social conditions in developing nations like Iraq (Iannuzzi 1965). But those specialists using the term openly struggled to pin down the definition of social infrastructure (Mytin 1964). The term itself arises from a strange marriage between a "warm" term typically describing human interaction - social, from the Latin *socialis* - and a "cold" one first used in 1927 which captures the mechanical systems required for the transactions of other activities - infrastructure.

Even though the term social infrastructure has been in use for more than six decades, disciplines continue to use the phrase without clearly defining it so that conceptual confusion abounds. An early 1990s paper published in a sociological journal focused on "entrepreneurial social infrastructure" defined social infrastructure as the "group level, interactive aspect of institutions" which had the dimensions of "symbolic diversity, resource mobilization, and quality of linkages" (Flora and Flora 1993). Typically, other fields see the concepts of diversity, mobilization, and linkage quality as their own unique categories of social phenomena, and not as social infrastructure. In 2022, an article focused on the consequences of the Paradise, California fires described social infrastructure as both the supporting social networks and also the physical places such as swim clubs, volunteer sites, and workplaces where sociality had been maintained (Brown 2022). Here we see the blurring of lines between the community's physical infrastructure itself - gyms, mosques, offices - and the intangible social ties being created and strengthened within those spaces.

Recent uses of the term lump together a variety of disparate elements and make it incredibly encompassing, as in this definition from the Private Infrastructure Development Group:

> Social infrastructure includes the construction and maintenance of facilities that support social services. These can include healthcare (medical facilities and ancillary infrastructure), education (schools, universities and student accommodation), and housing (PIDG 2022).

Other institutions, such as the New Zealand Social Infrastructure Fund also cast a broad net in their attempt to pin the term down: "Social Infrastructure is a subset of the infrastructure sector and typically includes assets that accommodate social services" (NSCIF 2009). Scholars working in Australia similarly argued that "social infrastructure is defined as life-long social service needs related to health, education, early childhood,

community support, community development, culture, sport and recreation, parks and emergency services" (Davern, Gunn, Whitzman, Higgs, Giles-Corti, SImons, Villanueva, Mavoa, Roberts, and Badland 2017). When scholars and practitioners cannot agree on a focused definition of a phrase and continue to use overly broad approaches to the concept, we lose our ability to use the term effectively.

This article uses a review of nearly 150 articles to trace the meaning of the phrase social infrastructure over time. Our large sample from a variety of fields alongside business and scholarly platforms allows for an in-depth analysis of the term social infrastructure, and ensures that the best version of a definition is supported. This research adds to the existing literature in the fields of infrastructure and social science in several ways. First, ours is among the first articles to use a historically informed set of articles to better understand the ways that the term social infrastructure has been used. Rather than relying on recent, popular books and articles, or a single snapshot in time, we have assembled a dataset going back to the 1960s across a variety of fields. Additionally, our article is the first of its scope, as very few other pieces of research have looked through the extensive literature that this article includes.

Next, rather than merely summarizing the literature, we use data visualization to illustrate the popularity of certain categories of definition over time, and then use excerpts from those articles, books, and financial reports. In this way our piece takes a mixed-methods approach, recognizing that any single way to analyze a social phenomenon has limitations (King, Keohane and Verba 2021). Finally, we illuminate how alternative definitions of social infrastructure confuse the field as many other approaches already have their own terminology, target for outcomes, and a non-social capital focus. Ultimately, the best solution for increasing the clarity of future research in this field is to streamline the definition of social capital into one that focuses on the networking social capital aspects that the term encompasses.

Data and Methods

We collected the top search results from seven major platforms - Google, Sage Journals, Google Scholar, JSTOR, EBSCO, ABI Inform, and ResearchGate - for articles using the phrase "social infrastructure." We discarded hits that had the phrase but insufficient available citation information (such as the date and author), information critical for replication. Additionally, we discarded any hits that were not in the English language or lacked authorized English translations. Of the remaining documents, we excluded several false positives which lacked the term social infrastructure. From among the remaining articles, 22 used the term social infrastructure without making it clear what they were referring to, and were therefore dropped, while another 17 were dropped because of ambiguity in their definition. The remaining 84 articles, economic thought pieces, blog posts, government reports, and bank publications formed the basis of our analysis of the use of the term social infrastructure over time.

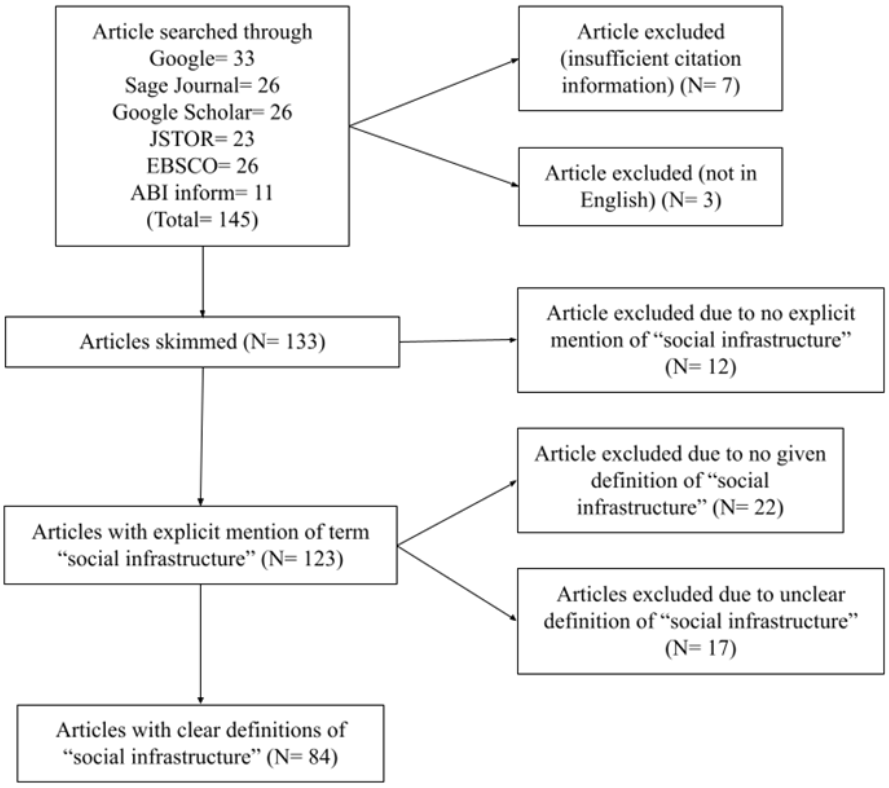

Figure 1. Methodology

Using those remaining 84 texts, we began by coding them based on core concepts, and our coders converged on the five categories identified below. We have assembled a bibliography of all sources in Appendix A.

Results: Five Categories

Our analysis finds that scholars used social infrastructure in ways that generally fit into five categories.

The first category of social infrastructure referencing articles revolves around facilities in the field of **education**, that is, places that provide systemic education and instruction, including daycare centers, kindergartens, K-12 schools, trade schools, and universities. Scholars tend to pair education with later categories such as healthcare and housing in their definitions of social infrastructure. Indeed, definitions along the lines of "educational, health and other primary services that provide basic amenities and enhance the quality of life" (Kumar 2009) were quite common in our findings.

The earliest reference to social infrastructure as related to education came from a 1960 New York Times article which recognized that the term was one known to sociologists which "emphasiz[ed] housing, agricultural extension projects, agricultural credit plans, education, and health" (Schmidt 1960). The term's highly flexible first use in a major publication demonstrated that experts did not agree on a single understanding.

Unfortunately by the late 1980s, the use of education as part of the definition of social infrastructure became even more generalized. For example, when a Polish researcher commented on the role of social infrastructure in socialist countries in eastern Europe, they defined it as "The range of the needs covers all the so-called non productive sectors of the national economy: housing, education, health care, welfare, culture and arts, tourism, sports, and recreation, as well as retailing and services" (Ciechocińska 1988). We note that the author saw these aspects of society as "non productive sectors," one often connected negatively with economic growth (or stagnation).

In the early 1990s, a study from the American Academy of Political and Social Science referred to entrepreneurial social infrastructure (ESI), a subsection of social infrastructure that focuses on improving the economic state of a nation. The authors of this study distanced their definition of social infrastructure from phenomena involving human capital and human resources, focusing instead on things that were "a product of collective human endeavor" (Flora and Flora 1993).

As of 2022, scholars continued to refer to facilities connected to education using the phrase social infrastructure, as a business school professor did when focusing on ensuring that young Japanese couples would feel encouraged to have children in an era of declining fertility. He argued that "The 1990s was a pivotal decade in the making of a state-sponsored welfare state. Japan invested heavily in social infrastructures such as child care and aged care facilities" (Ono 2022).

The field of education has several key infrastructural concepts already associated with it, including human capital and educational facilities. For instance, in an American study observing educational reform in teaching mathematics, researchers specifically noted the term "educational infrastructure," defining it as "features such as structured routines and/or instructional coaches" (Shirrell et al. 2018). Additionally, in a World Bank article outlining the importance of educational infrastructure, the term was defined as "buildings, classrooms, laboratories, and equipment" (Teixeria et al. 2017). Both of these instances underscore how the field of education already has its own, distinct uses for the term infrastructure. Engaging the term social infrastructure for these facilities and spaces adds little value to the field. Educational analysts, economists, and other specialists understand schools as increasing *human*, not social capital.

The second category our research has uncovered as often connected to social infrastructure is **healthcare**, that is, locations providing organized medical care to individuals or a community. Many authors seemed to regard this category as a "foundational" service that "support[s] the quality of life of a location" (Spacey 2019). This category was also frequently paired with education and housing, which we hypothesize may be due to the fact that all three of these categories are generally considered foundational (or "nonproductive") services needed within a community.

The earliest reference we found to healthcare came from a 1960 New York Times article explaining that sociologists envisioned social infrastructure as infrastructure which "emphasiz[ed] housing, agricultural extension projects, agricultural credit plans, education, and health" (Schmidt 1960). Once again, the term's highly flexible first use in a major publication demonstrated that experts did not agree on a single understanding.

As time passed, scholars did not come to a consensus on healthcare infrastructure as social infrastructure. A Polish study examined the effects of social infrastructure on transforming Eastern European economies looked closely at privatized housing. Specifically, the authors of the study regarded social infrastructure as "assets that do not have any direct commercial gain, and are instead to help the employees of a corporation" such as healthcare (Dobek and Thurmaier 1997). Here again, scholars connect social infrastructure to nonproductive assets.

Medical and health policy practitioners already have a specialized type of term for facilities in their field, namely healthcare infrastructure. For instance, the Deputy Executive Director of the American Society for Health Care Engineering (ASHE) defined the term healthcare infrastructure as "the individuals, facilities, and buildings required to deliver world-class health care. This complex term includes the components comprising basic hospital delivery of services, including both structural and maintenance of facilities" (Beebe et al. 2021). Additionally, the term healthcare infrastructure even has more specific definitions when it comes to individual sectors within healthcare. The Centers for Disease Control and Protection's definition of *public* healthcare infrastructure involves "the people, services, and services needed to promote and protect health" (CDC 2022). As with education, we find that definitions of social infrastructure stretching to include health intrude into an already well-defined field, and do little to further our understanding of the term.

The third category of references to social infrastructure involves **housing**, which we define as a place of residency. Scholars in this field regard housing as a "facility which serve[s] to satisfy the needs of an individual and of households" (Ciechocińska 1988), which although technically true, has little to do with social interactions or networking. It has appeared frequently enough over time, nonetheless.

One of the earliest references to housing as a form of social infrastructure came in a 1974 Japanese study evaluating the challenges Japan would face following the wars the nation was involved in throughout the 20th century. Researchers referred to social infrastructure as "public housing, transportation, sanitation, medical services, and social welfare program[s]" (Ozawa 1974). The vague nature of this definition hints at how the term social infrastructure is fundamentally being applied in a manner that is too broad for its intended use. All of the services listed by Ozawa connect to each other only through the fact that they are typically funded by the Japanese central government. However, these fields also have privatized elements, so this overly broad approach does little to further our understanding of the term.

A reference to housing in the late 1990s comes from an article that examines why worker output varies so greatly across different countries. The authors report that differences in social infrastructure are to blame. Using a somewhat cyclical definition, the authors describe social infrastructure as, "the institutions... that determine the economic environment within which individuals accumulate skills, and firms accumulate capital and produce output" (Hall and Jones 1999). To clear this definition up further, the authors explain that, "a good social infrastructure will plug as many holes as it can where otherwise people could spend time bettering themselves economically by methods other than production." Essentially, they define social infrastructure as locations where self-improvement can occur, such as one's home.

Scholars using the term social infrastructure to describe public and private sector housing run into challenges as many scholars already describe housing and residences using their own terms. For example, in a legal context, the term housing infrastructure refers to "basic facilities, services, systems, and installations necessary or appropriate for the functioning of a housing community, including facilities, services, systems, and installations for water, sewage, power, communications, and transportation" (Law Insider 2013). The specificity of this definition illustrates why using such a term to refer to housing is a fruitless task that only complicates the fields. A Polish study arguing for the importance of housing infrastructure in smart cities, for example, observed that housing infrastructure involved housing units along with amenities such as, "central heating, water supply, bathroom, flushing toilet, [and] mains gas" (Jonek-Kowalska 2022). Given that scholars studying housing use the phrase housing infrastructure to capture relevant phenomena, we see its connections to social infrastructure as tenuous at best.

The fourth category of references to social infrastructure comes in the field of **transport**. Defined as a system or means of conveying people from place to place by various means, transport was likely the most puzzling field observers have sought to connect to social infrastructure. Scholars have argued that transport is a " form of infrastructure that maintains a high reliability and is accessed by many people" (Yamane, Ito, and Higuchi 2021), and should be included under the umbrella of social infrastructure.

Our research found that the earliest reference to transport as a type of social infrastructure came in 1969 in an American study that observed the role of cities in national development. Though the focus of the research was not on social infrastructure, social infrastructure was cited as one method of improving national development. Specifically, the researchers pointed out that, "a progressive expansion of transport and communication capacity over larger areas" and, "an increase in the speed and efficiency of ... transport" were both characteristics of modern development that were a part of social infrastructure (Friedmann 1969). The link the researchers make from transportation to social infrastructure further muddied the waters.

As time progressed, the connections between social infrastructure in relation to transport changed. For example, a 2002 Australian study focused on the efficacy of crime prevention movements and efforts, brought up the term social infrastructure as a method to prevent crime. Specifically, the authors focused on the importance of safety on public transport as a part of social infrastructure (Sutton et al. 2002). As seen with the last definition of social infrastructure focused on transportation, this definition too falls on very questionable logic. We see continued confusion in the term's use in the vision statement of the electric vehicle company Terra Motors: "building new social infrastructure through transportation and the internet." The company actually leases electric three-wheelers, and does not create social ties.

Scholars who use the term social infrastructure to refer to transport-related phenomena create conceptual confusion as many scholars already use the term transportation infrastructure. Using the term social infrastructure in this way overlaps with an existing field of study and does not clarify its use. For instance, in a 2017 Latvian study on the performance of transport infrastructure, the term was defined as infrastructure that "facilitates the development of connections between regions within a country and between countries, and consequently [and] supports the formation of mutual economic, social, cultural relations" (Skorobogatova & Kuzmina-Merlino, 2017). In contrast with the previous definitions of social infrastructure that refer to transport, the definition provided for transport infrastructure itself is a far more focused definition. Additionally, in a 2018 study that analyzed the relationship between transport infrastructure and green development, the term was similarly classified as "a complex network, [that] connects cities and accommodates human activities coupling the social, economic and environmental systems with the urbanization and population growth" (Wang et al. 2018). Given the use of the phrase transportation infrastructure across a variety of scholarly and practitioner fields, and its very tenuous connections to social networks, we again see little use in pursuing this category of definitions.

The final category-- which we also advocate as a focal point for the field -- involves **networking spaces**. Networking spaces involve locations where people can interact to build relationships and strengthen community ties, including social businesses such as cafes, barbershops, restaurants, parks, gyms, recreation centers, community gardens, and dog walking trails. A pioneer of this definition category defined social infrastructure as "physical gathering spaces where social connections can be formed and democracy can be maintained within a community" (Klinenberg 2018). This conception of social infrastructure centers around social ties and social connections, directly addressing the "social" element referenced by the term social infrastructure.

As networking spaces encompass a wide variety of virtual and physical locations, including Facebook pages, community gardens, parks, dog walking spaces, social businesses, restaurants, sidewalks, etc. using the term social infrastructure helps to capture the benefits from these kinds of spaces in a concise manner while still maintaining a reasonable sense of generality. The term is neither too wide nor too narrow. Further, narrowing down the definition of social infrastructure to social network creation and maintenance avoids the challenges of the term interfering with already well-defined fields, such as healthcare, housing, transportation, and education.

For instance, when millions of Japanese cell phone users lost connections for nearly two days, reporters summarized the apology from the head of the telecommunications company KDDI saying, "Reiterating his call for carriers to keep in mind that cell phones are an important part of social infrastructure, Kaneko said appropriate steps would be taken to deal with the matter, hinting at the issuance of an administrative order" (NikkeiAsia, 2022). Phones, indeed, provide access to social infrastructure, especially social networking sites, where so many people find common interests and participate in affinity groups.

Definition Category/School of Thought	**Summary of category**	**Examples from the literature**
Education	Locations providing systemic education.	Public and private schools, universities (PIDG 2022, Kaklotar 2017)
Healthcare	Locations providing organized medical care to individuals or a community.	Hospitals, community medical centers, dental clinics (Abadie 2021, Brauch 2017)
Housing	Places of residence.	Private housing, public apartment blocks, communal housing (Lubelsky and Hodgins 2019, Wulandari 2021)
Transport	A system or means of conveying people from place to place by various means.	Bus, train, tram, and subway systems (InsightIAS 2022, Yamane et al 2021)
Networking Spaces	Locations where day-to-day human interaction can build relationships between individuals and strengthen community ties	Cafes, restaurants, sidewalks, grocery stores, libraries, parks, gyms, mosques, synagogues, churches, amusement parks, casinos, concert halls (Klinenberg 2018, Grum and Grum 2022)

Table 1. Categories of Social Infrastructure

Table 1 above summarizes the core categories into which these more than 80 articles and field pieces fell along with prime examples from those analyzed texts. Additionally, as noted above, a number of the definitional categories already have specialized terminology to capture the core elements of their framework.

Definition Category / School of Thought	**Targeted Outcome**	**Terms of Art for that Facility Type**	**Connection to social capital and networks**
Education	Human capital	Education infrastructure; Schools	Mixed
Healthcare	Health	Healthcare infrastructure	Little / none
Housing	Human needs / services	Housing infrastructure; homes	Some
Transport	Mobility (goods and services)	Transportation Infrastructure	Some
Networking places	Social capital	Social Infrastructure	Strong

Table 2. Connections between Categories, Existing Terminology, and Social Capital

Table 2 above further details the core categories this study has outlined for the term social infrastructure. Specifically, the table underscores that in many of these categories, terms of art - such as transportation infrastructure or health infrastructure - already capture the main elements of that approach, rendering their inclusion in the field of social inclusion challenging.

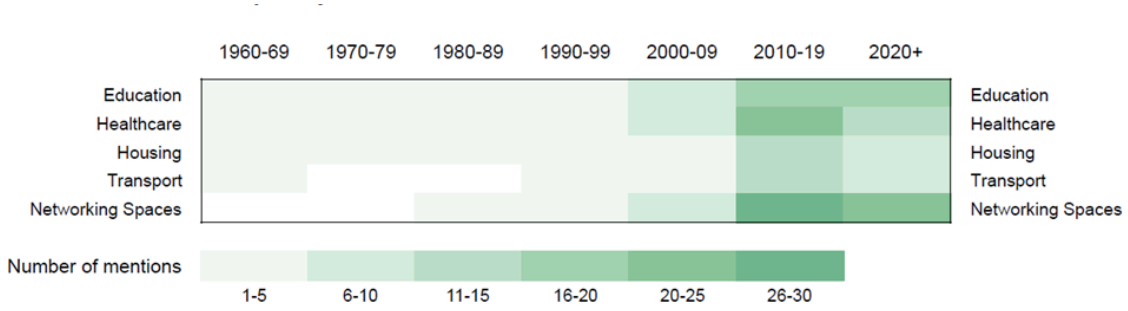

Figure 1. Frequency of Various Definitions of "Social Infrastructure" from 1960 to 2022

Figure 1 above uses a heat map visualization to demonstrate the degree to which articles fit into the five core categories over time. Lighter shades indicate fewer articles in that category. The category of networking spaces does not appear as a core definitional framework until the 1980s, while the other four were in use from the 1960s. By the early 21st century, the category of networking spaces has started appearing regularly, so that by the 2010-2019 and the 2020+ eras many articles using the term social infrastructure do so in reference to networking spaces, whether in virtual space or real life. We believe that one of the anchor works to start coalescing the field came from Klinenberg (2018). But also note that even as late as the 2020+ period many references to social infrastructure still involve education, followed by healthcare, and then housing and transport. Despite the popularity of networking spaces, the term remains contested and unanchored, and this remains a problem for the field.

Discussion

Although social infrastructure came into being as a term in the 1960s and has been in continuous use by a variety of fields in the private, public, and academic sectors, we still lack a consistent definition over time, space, and field. As recently as the early 2020s reporters, practitioners, and scholars continue to lump a variety of service-providing facilities together into the category of social infrastructure, including one approach which included "health, education, early childhood, community support, community development, culture, sport and recreation, parks and emergency services" in the category (Australian Urban Observatory 2022). The chairman of a Japanese manufacturing firm that makes iron pipes, valves, building materials, and construction and manufacturing machines argued that the company's industrial equipment supported Japan's "social infrastructure," by which it was clear he meant all things transportation and infrastructure related (Kushida 2022).

When scholars and practitioners use the term social infrastructure to refer to phenomena in existing fields of study - such as education, healthcare, housing, and transport - they blur the clear, qualitative differences between these fields by straying into already well-clarified events and processes. Housing, transportation, and healthcare infrastructure, among 13 other fields, have already been identified by the United States government as categories of infrastructure which need special attention and protection (White House 2013). Social infrastructure has not.

We have shown evidence that the use of the term social infrastructure better fits with an approach centered on networking spaces. By narrowing the scope of the term and better connecting it to the words which make it up, namely infrastructure which strengthens and maintains social ties, we hope to make the term more useful and more used. Recent research on this type of social infrastructure has demonstrated a variety of remarkable attributes, including the ability of such facilities to mitigate the impact of major shocks such as tsunamis (Aldrich 2023). Through a focus on networking spaces scholars have also shown how these kinds of facilities are not distributed evenly across neighborhoods, instead often being present in weather, whiter areas (Fraser et al 2022). As societies struggle to mitigate the impact of extreme weather events from climate change along with broader challenges such as extreme polarization, social infrastructure may provide a road forward (Panagopoulos et al 2022). Without a clear definition and consistent use, however, the potential lessons learned will likely be understudied and underutilized.

Conclusions

Much public policy energy has been focused on financing and maintaining high-quality infrastructure projects which are needed to "improve economic productivity, transition to a low-carbon economy, mitigate environmental risks, and promote human rights and social inclusion" (Losos

and Fetter 2022: 3). Indeed, in North America the American Society of Civil Engineers regularly gives bridges, roads, ports, and other gray infrastructure low or failing grades, so new investments - such as those from the Biden Administration - are welcome

But most of our attention to the benefits of infrastructure has focused on gray infrastructure and overlooked the field of social infrastructure. Without a clear, broadly accepted definition of the term, and with the high cost of standard gray infrastructure projects, the social benefits generated from networking spaces have often been overlooked. Because of the overly broad use of the term to capture phenomena already studied in other policy fields - such as transportation, education, and health- less scholarship has examined the positive externalities of social infrastructure. We hope that this article will be a step forward towards a more rigorous and engaged look at the field of social infrastructure.

Acknowledgements

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Appendix A: 145 Sources for Analysis

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